REPORT

OF

THE SPECIAL COMMITTEE,

APPOINTED BY THE LAST LEGISLATURE TO REPORT ON THE BEST METHOD OF OBTAINING A COMPLETE

GEOLOGICAL SURVEY

OF

THE STATE OF OHIO.

COLUMBUS:

JAMES B. GARDINER, PRINTER TO THE STATE.

1836.

REPORT

To his Excellency, Robert Lucas,
Governor of Ohio:

The undersigned, having been appointed a Committee, under a resolution of the Honorable Legislature of the State of Ohio, passed the 14th day of March, A. D. 1836, "to report to the next Legislature the best method of obtaining a complete Geological survey of the State, and an estimate of the probable cost of the same," have had the said resolution under consideration, and report as follows:

In making any thing like a satisfactory report on so important a subject, as a Geological survey of a great territory like that of Ohio—embracing a variety of soils, and such various aspects of surface, your Committee were persuaded it would be necessary for them to visit, in person, the most interesting districts for valuable minerals and fossils; especially those portions known to abound in iron ores, coal, and salt; the three main staples on which the future millions of Ohio must depend for their manufacturing wealth and greatness.—Far removed from the shores of the ocean, and precluded from partaking in foreign commerce, that boundless mean of riches to the Atlantic states, Ohio must depend on her own resources, and seek, within her own bosom, for the supports of independence. Her luxuriant and exhaustless soil—capable of yielding bread-stuffs in greater quantities than ancient Egypt—with cattle, wool, and the productions of the dairy equal to those of any other land, possesses, in addition to all these, inexhaustable riches yet hidden in the bowels of the earth. And although the surface is yielding millions to the plough-share, that below the surface is capable of furnishing still more numerous millions.

From the fact that Ohio possesses no elevated ranges of mountains, we should at first sight be led to conclude that her rock strata contained few or no minerals; and it was in fact for many years after its first settlement, supposed that the inhabitants would be always dependent, as they then were, on the Atlantic states for the two great and indispensable articles to an agricultural people, salt and iron. But as the country became cultivated, and its resources more developed, it was found that these two commodities were amongst the most abundant productions of the region skirting the western declivities of the Alleghany ranges. The valley of the Ohio, from the mouth of the Scioto river to the country above Pittsburgh, is composed of alternate strata of sand rocks, lime stone, bituminous coal, iron ores and shales, resting on a stratum containing muriate of soda, or marine salt; and extending to an unknown depth. From its vast extent, we are led to conclude that it is deposited in exhaustless quantities. These several series of strata were originally deposited in nearly horizontal beds; but subsequently raised into mountain ranges on

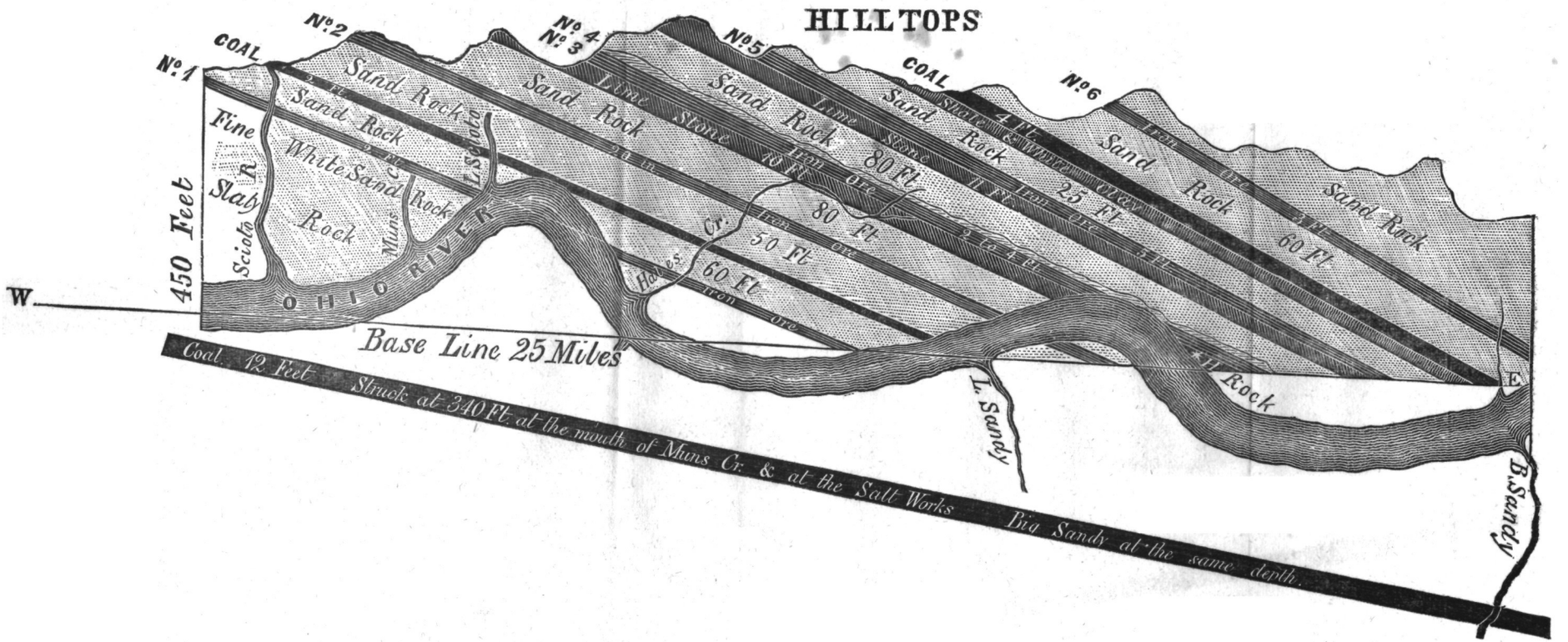
the east, and south east borders of the valley; and into table lands, west and north of the sand stone rocks in Ohio and Pennsylvania. Through the most depending portion of this valley, the Ohio river now slowly and calmly winds its way, skirted by hills of an elevation of from two hundred to three hundred and fifty feet. These hills, at some remote period, were doutless united in continuous strata; from the well known fact, that beds of coal, iron ore, sand rocks, &c., found at a certain elevation in the hills, on the right bank of the river, are also found at the same elevation, on the left bank; demonstrating that the present hills were formed by the wasting away, in the course of ages, from rains, floods, and frosts, of the intermediate rocks and earths; and leaving the residue of the strata in their present form of hills, valleys, and deep ravines. This wasting of the strata, has not only completely drained the country of the waters which once covered it, and fitted it for cultivation and the residence of man, but has also brought to light, under very favorable circumstances, the different strata of coal and iron ores, that would otherwise have been concealed beneath the surface of the earth. This hilly, broken region, so lightly esteemed by the agriculturalist, has been wisely prepared by the Creator, in the most convenient and accommodating manner, for the comfort and happiness of man; the coal and iron being so placed by the wasting away of the original strata, as to be accessible with the least possible labor and expense—while we have every reason for believing that still thicker and more rich deposites of mineral coal and iron ore are placed deeper in the earth, to reward the industry, and supply the wants of man, when this valley shall be thickly populated, and the wealth of the country adequate to the expense of deep, underground mining, such as is at present practised in Germany and Great Britain.

With the view of ascertaining what the State really afforded in its mineral capacity—in order to render it desirable that a Geological survey should be made, the Committee have personally visited some of the most interesting portions, and particularly ascertained, from intelligent individuals, the resources of such parts as they could not examine themselves.

IRON ORE DEPOSITES.

Commencing, then, with the iron ore beds of Scioto and Lawrence counties, as paramount in importance to that of any other mineral deposites in the state, we find the main beds commencing about fourteen miles above Portsmouth, near the Ohio river, where the ore is seen cropping out on the tops and sides of the hills; and was first brought into use about the year 1828. The combined series of minerals, here associated, is so interesting, and their present and future importance so vast and influential on the wealth and greatness of the state, that the committee have thought it best to attach a diagram, illustrating animaginary section of the region, extending from the mouth of the Scioto to Ice creek, a point between Burlington and Hanging-rock. It commences with the lowest bed of iron ore, resting on a fine grained sand stone, which underlies all this region; extending far up the Scioto to Waverly, and bearing off north easterly, across the counties of Fairfield and Licking; coming occasionally to the surface, but lying under the coarser sand rocks, which are alternately with the iron and coal of the hilly parts of the state. We shall refer to this rock again, in another place.

These several deposites of iron ores, extending to six or more distinct beds, lie at an inclination of about thirty feet to the mile, dipping to the east, south east; and are seen, as we travel easterly, cropping out at successive, but irregular intervals, on the surface of the highest hills, at a few miles back from the river, and gradually sinking deeper in the earth,


HILLTOPS
No. 1
No. 2
No. 3
No. 4
No. 5
No. 6
COAL
COAL
450 Feet
W
Fine Slaty R.
Scioto R.
Sand Rock
White Sand Rock
Sand Rock
Muns. Cr.
Sand Rock
OHIO RIVER
Sand Rock
Lime Stone
40 Ft.
from ore
Sand Rock
Lime Stone
80 Ft.
from ore
80 Ft.
from ore
50 Ft.
from ore
60 Ft.
from ore
Hols. Cr.
Sand Rock
4 Ft. Shale & White Clay
25 Ft.
from ore
Sand Rock
60 Ft.
from ore
Sand Rock
Rock
L. Sandy
B. Sandy
Base Line 25 Miles
Coal 12 Feet Struck at 340 Ft. at the mouth of Muns Cr. & at the Salt Works Big Sandy at the same depth.

are finally lost at the base of the hills, disappearing beneath the beds of the streams. The diagram will illustrate the descriptions which follow, and is true, as it relates to the order of superposition, or succession of the different strata.

Commencing, then, with ore bed No. one, we find it at the Franklin furnace, in Scioto county, sixteen miles above Portsmouth, resting on the main, fine grained sand rock, at an elevation of one hundred feet above the bed of the Ohio river. The hills here are estimated to attain an elevation of three hundred feet. It is a porous silicious ore, two feet in thickness, resembling, in external appearance, that variety called "Bog-ore;" and is probably the same deposite which is found on the west side of the Scioto river, in Adams county, and worked at the steam and marble furnaces. It is not at present in use at this place, from the circumstance of a much richer ore being found here in abundance. It will however, without doubt, be brought into use at a future day. Its comparative value, as a workable ore, may be seen in the appendix, with the analysis of the several ores, where it is found to afford —— per cent. of iron.

Reposing on ore bed No. one, is found a deposite of sand rock, sixty feet in thickness; the upper portion of which is nearly white, fine grained; and found to be a valuable material in constructing the furnace hearths—sustaining a great degree of heat without fusion or fracture. It often contains imbedded fragments of pure mineral charcoal; rendering it porous when burnt, and in some respects resembling the composition of the portable furnaces in use for culinary purposes; which resist fracture, from the action of heat, by having a portion of saw dust mixed in the composition; this burning out when heated, leaves them to shrink and expand without injury. It is a very valuable material to the furnace holders, as they thus find on the spot, an article which in many places, has to be transported from considerable distances. Resting on the sand rock, is a bed of bituminous coal, from two to three feet in thickness; varying in this respect at different places. It is worked for the purpose of supplying fuel to the steam engines in use at the furnaces, to keep up the blast. The roof of the coal bed is composed of slate and bituminous shale, six feet in thickness. Reposing on the shale, we find a bed of coarse sand rock, containing considerable mica; this bed is about fifty feet in thickness—on this sand rock, lies ore bed No. two. This is also a silicious ore; containing a few fossil shells. It is less porous, and more compact and heavy than No. one. The bed is about twenty inches thick at this spot; and is extensively worked at Darlington's furnace, in Kentucky, four miles westerly from the Franklin furnace. It affords one of the best metals for bar iron, and is remarkably malleable and tough. By those who have made the experiment, it is said to exceed the far-famed Juniata bar iron, in tenacity and strength.

By analysis this ore yields —— per cent. of iron. The roof of this bed is a coarse grained silicious sand rock—which becomes coarser as we approach the summits of the hills, eighty feet in thickness. Resting on the sand rock, is found a deposit of lime stone, wasted and gone, near the surface of the earth, but becoming solid and compact as the stratum descends deeper beneath the rocks. Some miles farther east, it is found to be eight or ten feet in thickness, and filled with fossil shells of a marine origin, whose species and genera are now no longer found living in the Atlantic seas.

Reposing on this deposit of lime stone, is found ore bed No. three—called by the workmen "Block ore," from the fact of its being found in oblong, cubic fragments, nearly continuous, and resembling, when first uncovered, the largest tiles of a brick hearth. This bed is from one to three feet in thickness, composed of two or three layers, when very thick; the upper ones being considerably thinner than the lower or main bed, and

separated by thin layers of slate. It is a rich calcareous ore, abounding in carbon, and affording one of the finest metals for castings; being not only very tough, but also exhibiting a lustrous surface, as if recently coated over with a solution of black lead. Articles manufactured from this ore are very beautiful, and the metal in great demand for stoves, and castings for domestic uses. At the close of each blast, there is found lying on the hearth of the furnace, where this ore is used, a slag of six or eight hundred pounds weight, containing a metal of high specific gravity. Its fracture and metalic lustre is very similar to that of specular oxyde of iron, from the primitive rocks on Lake Champlain, and affords an illustration of the theory that the ores of primitive rocks have once been, and that for a considerable period of time, in a state of fusion. It leaves a streak similar to that of Graphite, or black lead, and soils the fingers when handled. The analysis of this mineral is given in the appendix. The ore No. three, or "Block ore," is a rich calcareous ore, yielding, by the common process of smelting and cold blast, about fifty per cent. of iron. When dug and exposed to the atmosphere, it separates into thin concentric layers, of a rich brown color, and when roasted, preparatory to smelting, it assumes a deep, bright red tint, in some instances approaching the hue of vermillion. It also contains many rare and beautiful casts of fossil shells replaced by the purest ore, and affording an exhaustless supply of specimens for the naturalist, and future students, of organic remains in Ohio. This deposit crowns the summits of the hills, in the vicinity of the Franklin furnace, coming up on to the surface, a few miles northwesterly, and disappears or runs out as we approach within a few miles of the Scioto river—while to the east, and south east, it is found gradually descending to the base of the hills, as high up the Ohio as Storms creek, in Lawrence county, occupying a space of more than ten miles in width, and finally disappearing under the beds of the streams, in a thick deposit, ready to reward the future miners of Ohio, when the surface beds are exhausted. Its extent north easterly is at present unknown; but there are many reasons for believing that this deposit streatches in a broad belt, diagonally across the state, to the vicinity of Lake Erie, or at least as far as the coal measures are found in that direction.

No. four is a thin bed of "kidney ore," in concentric masses, lying from a few inches to a few feet above the "Block ore," in a bed of argillaceous shale; as the two beds descend deeper into the earth, they finally become united into one. The ore also becomes more compact, and changes its brown hue into a dove color, or pale blue. This is doubtless its original tint, but has been changed by gradual oxydation, as the deposit approached the surface of the earth, and became partially exposed to atmospheric influence, from the degradation and wasting away of the superincumbent strata in the long lapse of ages. The same deposit with No. four, or an equivalent one, is believed to be found near Zoar, in Tuscarawas county, and at several intermediate places, as noticed in the American Journal of Science, vol. 31, page 16. The analysis of ore No. four, is given in the appendix.

In progressing easterly with the development of the successive strata, we find reposing on ore bed No. four a coarse grained sand-rock; often containing fossil remains of trees, and vegetable relics, lying in different deposites and beds of variable thickness, the whole amounting to about eighty feet. Resting on the sand stone is another bed of lime stone, eleven feet in thickness. It is a dark colored, compact rock, containing fossi

shells, and affording a suitable material for fluxing the iron ores.—About three miles south east from the Franklin furnace, ore bed No. five, come to the surface, and is found crowning the tops of the adjacent hills. This bed rests immediately on the lime rock, a few miles further east, and deeper in the earth; but at its first cropping out reposes on a bed of silicious rock, much resembling that found in Jackson and Muskingum counties, and is probably a spur or lateral branch of the great silicious deposit, to be noticed hereafter. The deposit of ore is here from three to four feet in thickness, and of a cellular, rough aspect; and is known to the workmen by the name of "rough ore." As it progresses south east, the bed dips deeper into the earth, and changes its aspect to a light dove color, becoming more compact, and requiring to be blasted with gun powder, to separate it from its rocky bed, instead of being raised with pecks, or iron bars, as is common when it lies near the surface. The rock on which it lies, soon changes to a firm, compact limestone, and looses its silicious character. When found in detached masses near the tops and sides of hills, it is ochery, or orange colored, with numerous cavities lined with mamillary processes, of chrystalized carbonate of iron, some of which are very beautiful, and afford nice specimens for the cabinet. The ore is from two to five and six feet in thickness; the upper surface of the bed being undulated, but the under surface resting on the lime rock is smooth and uniform. It also improves in quality as it increases in thickness.—This bed is easily traced to the distance of ten or twelve miles in a south easterly direction, and finally disappears beneath the bed of the river, at "coal grove," above Hanging Rock. It is extensively worked at all the upper furnaces in Lawrence county, and also in Kentucky. Its extent, in the line of its bearing, is yet unknown; but is probably continuous with number three, as a similar ore is believed to be found and worked below Zoar, in Tuscarawas county. It may probablybe reached by shafts many miles further east, and afford exhaustless supplies to the future manufacturers of the west. When smelted, it yields about fifty per cent. of very fine iron. The analysis is given in the appendix at No.

Reposing on No. 5, lies a deposit of brown argillaceous shale, nine feet in thickness, resting on which is a bed of fine white clay, three feet in thickness, of a quality suitable for pottery, or as a material for fire bricks. It is already extensively used in the manufacture of stone ware; and has also been found to yield with dilute sulphuric acid, a fine sulphate of alumina, or allum. The white clay forms the floor of a bed of bituminous coal, four or five feet in thickness. It is said to burn freely, and is thought will be exceedingly valuable in the smelting of ores, when the "*hot blast*" shall be brought into use, as it already is at some of the furnaces, and must soon be at them all. If its success is equal to the statements made in the European journals, as noted in the appendix [A[a new era will commence in the iron manufacture; and not only a larger amount be obtained with a less quantity of fuel, but also a better article of iron. The immediate roof of the coal is composed of a chocolate colored shale, reposing on which rests a bed of sand stone, sixty feet in thickness. The lower portions of this rock contain numerous imbedded fragments of coal. Resting on the sand rock is found a thin bed of yellowish, or cream colored limestone, probably tinged by ore bed No. six, which here crowns the tops of the hills. It is a calcareous ore and needs no addition of lime in fluxing. The structure of this ore is very different from that of the other beds; resembling a mass of aglutinated pebbles, or a closely aggregated pudding stone. It affords about fifteen or twenty per cent. of iron, but is as yet little used by the furnaces. The bed is three feet in thickness, and

would probably afford more than four thousand tons of ore to the acre. It is apparently either the same, or an equivalent bed to that described as No. one, at Dillon's furnace, in Muskingum county. This deposit is the last of the series of ores yet noticed on the Ohio side of the river; but on the Big Sandy river, a few miles from the mouth, are extensive beds of limestone iron ore, from eight to ten feet in thickness. This ore has been used at the "Oakland furnace," and yields about thirty-three per cent. of iron. It will, without doubt, be found in Ohio, in a similar parallel whenever a regular survey of the State shall be made.

With these immense, and apparently exhaustless supplies of iron at her command, what shall prevent Ohio from becoming one of the first manufacturing states in the Union? Cincinnati, emphatically called "the queen of the West," has within her reach all the means of wealth and greatness. The Ohio river, washing with its gentle current the ores and the coal as they lie slumbering along her shores, is ready to waft on her bosom, at all seasons of the year, and at the cheapest rates, a regular supply of materials to the door of the manufacturer. Her proximity to the iron will give her a decided advantage over Pittsburgh in the cost of the article; while the increased number of coal beds opening, and to be opened, will soon furnish coal at as cheap a rate as it is now furnished at the latter place.

LIST OF FURNACES IN SCIOTO AND LAWRENCE COUNTIES.

In order to aid in forming a correct estimate of the value and importance of the iron business to Ohio, in its present infant state, the Committee have subjoined a list of the furnaces in operation the past season, the amount of iron smelted, with its present value per year.

NAMES OF FURNACES.

Franklin, Junior, Scioto, Bloom and Clinton, in Scioto county.

Union, Pine Grove, Ætna, Vesuvius, Hecla, Lawrence, Mt. Vernon, and Buck Horn, in Lawrence county.

In addition to these, are two forges; the Lafayette and Hanging Rock.

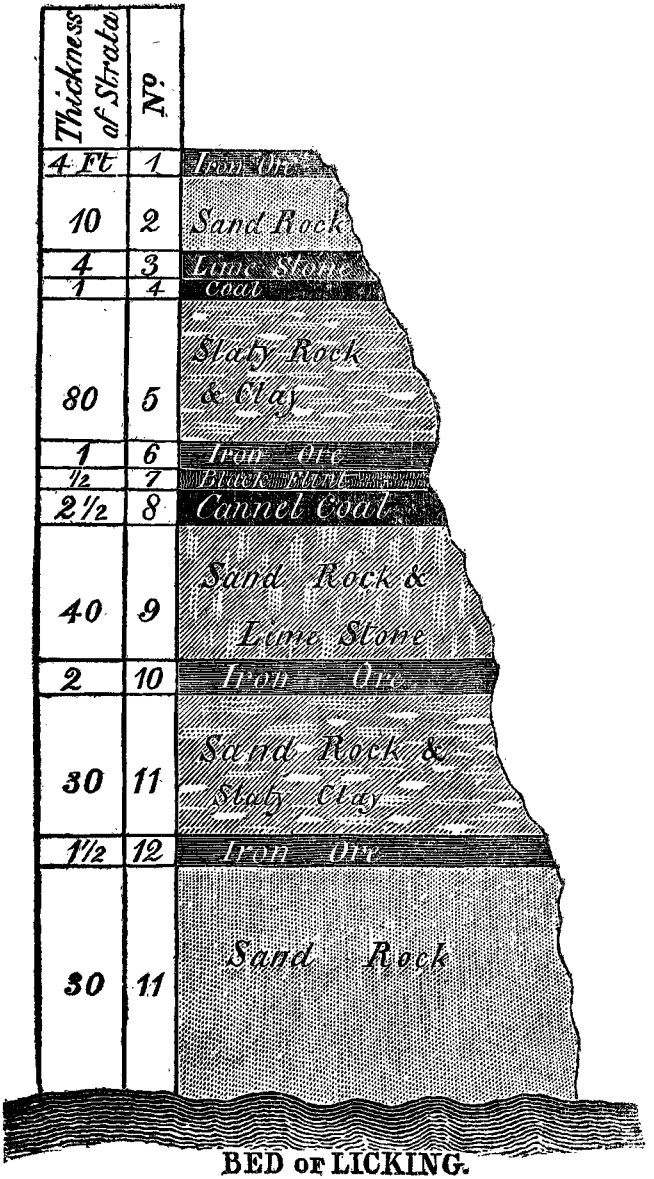
The furnaces make an average amount of one thousand tons of pig iron per year; some of them making more than this quantity and others less. During the past season, pig iron has been worth forty dollars per ton at the landing, where the metal is delivered to purchasers. Producing an amount of iron worth five hundred and twenty thousand dollars per year—one half of this quantity is made into castings and stoves, directly as the metal flows from the furnace, worth sixty dollars per ton, which will add one hundred and thirty thousand dollars more to the gross amount; making the sum of 650,000 dollars as the product of these 13 furnaces. The number of furnaces is steadily on the increase, several new ones going into operation the present year. In addition to which, the bar iron manufactured at the forges will swell the present amount to a considerable larger sum. Each furnace employs, on an average, about one hundred men, and fifty yoke of oxen—all which are fed from produce grown in these counties and those lying higher up the country on the Ohio and Muskingum rivers; affording an extensive home market for large quantities of corn, oats, flour, and bacon, and already nearly as important as that of Cincinnati, to many of the river counties. The furnaces on the Kentucky side of the Ohio river, in the iron ore region, are quite as numerous as those in this State, and assist in giving permanency and value to this new market. When the number of furnaces is quadrupled, as they in a short time must be, from the regularly increased demand for iron in rail roads, steam engines, &c., the value of the iron manufacture will be swelled to several

millions, and the market for the productions of the soil be proportionally increased. So true it is, that agriculture and manufactures are twin sisters, and go hand in hand, affording mutual benefit and assistance to each other.

IRON ORE BEDS IN MUSKINGUM COUNTY.

The probability of finding the same beds stretching in continuous deposits, nearly across the State, with only partial interpositions, is so great that the ore beds in Muskingum county, were also visited. How far this opinion is strengthened by the examination, will be shown in the section of strata given below. Every new fact leading to this conclusion, would add to the inducements for entering into a thorough geological survey of the State. Although at the first view, it may appear visionary to suppose that such vast and extensive deposits of ore can be found in any region of the earth, yet when we reflect that the operations of nature have been carried on in the valley of the Mississippi, of which Ohio is a part, with a grandeur and magnificence unknown to most parts of the earth, it will not be so difficult to believe. Having personally visited both the north and the south sides of the valley of the Ohio, and examined the different strata, we have come to the conclusion that the coal beds and iron ores, are systematically placed between vast and extensive deposits of sand rocks, shale, or clay slate and lime stone—which several strata were originally formed in a vast basin, covered with water, the gradual filling up of which has changed it to dry land. In the most depending part of this basin, the Ohio river now flows. Subsequent to this period, or during its progress, the Allegheny ranges were thrown up from below, and the table lands on the heads of the streams between Lake Erie and the Ohio, were also raised. Many of these deposits are doubtless extended entirely across the valley, as we are led to suppose from the products of the borings of salt wells, and from finding similar rocks on the two opposite sides of the basin, especially red sand stone, and mill stone grit, as at the falls of the Cuyahoga, and in the Gaula and Laurel mountains, as well as at other points around the margin of the coal basin. Both these rocks are known to underlie those deposits. From this raising of the borders of the valley, those strata which lie at the depth of several hundred feet in the centre of the basin, appear on the surface at the margin—while those which are at a less depth come to the surface in succession as we travel towards the centre of the basin, as is partially shown in the section of strata in Scioto and Lawrence counties. The same order as is there exhibited, varying, however, in thickness, quality, &c., it is more than probable, is continued all round the western and northern portions of the coal region. The rocks containing fossil salt, lay deeper than the bituminous coal, as the strongest and best water is found on the shores of the large streams, some distance from their heads, and after penetrating the upper coal deposits—although it is not unphilosophical to suppose that beds of anthracite may be found below the salt rocks, from the fact of sulphurated hydrogen and petroleum being discharged from the bottoms of the deepest wells, both of which are supposed to be the products of coal.

With these remarks, we now proceed to notice the arrangement of the strata, at a point about one mile west of Dillon's furnace. The section below will assist in rendering it more plain.



BED OF LICKING.

Stratum No. 1.—Iron ore, four feet in thickness, crowning the tops of the hills. It is in separate nodules, and kidney shaped masses, beded in a yellowish, ochery clay. In external character, and order of location, it corresponds with ore No. six, in Lawrence county. Those which lie below, crop out on the surface north and west of this bed, as they would of course do, being deeper in the earth. The ore is but sparingly used at present, from the circumstance of the metal not separating easily, and the workmen being as yet ignorant of a suitable flux. It is a heavy ore.

Analysis in the appendix.

2d.—Bed of coarse sand rock, on which the ore rests, ten feet.

3d.—Lime stone, 4 feet.

4th.—Coal, rather poor in quality, one foot.

5th. Shale and slaty clay, eighty feet.

6th.—Iron ore, in a continuous bed—breaking up into blocks. To every appearance it is the same, or an equivalent deposit with that of No. 5, a few miles east of the Franklin furnace, called "rough ore."

Analysis in the appendix, 1 foot.

In smelting it affords about fifty per cent of iron.

7th.—Black flint, or horn stone. The iron ore rests on this deposit of flint, and is in some measure incorporated with it. Six inches.

8th.—Cannel coal. This is a bituminous coal, but more compact, and conchoidal in its fracture than common coal. It has been most probably, subject to a greater heat after being deposited, from its proximity to the flint rock. It burns freely, and will afford a fine article in smelting of iron, when charcoal becomes scarce. Two and a half feet.

9th.—Sand rock and lime stone, forty feet.

10th.—Argillaceous iron ore, resting on a thin bed of black earth, beneath which is clay.

This ore contains fossil shells, of the same species as those in beds No. 3 and 4, in Scioto county. It separates into scales, when exposed to the air, assumes the same hues when roasted, and in every respect appears to be a similar ore to the "block ore"—many of the fragments after roasting shew a columner structure like the ore at Zoar. It is a rich, fine ore, and affords the larger portion of the material used at this furnace.

Analysis in the appendix—2 feet.

In smelting it yields from 40 to 50 per cent. of iron.

11th—Sand rock and slaty clay 30 feet.

12th—Calcareous iron ore—This ore is at present brought from a distance of three miles, up the Muskingum, in a N. E. direction, and may possibly be a continuation of the argillaceous ore, changing its character as it dips deeper into the earth—although it is most probably a distinct bed. It is mixed with the ore from the bed above at the furnace, and affords a fine article of iron 1½ feet.

Analysis in the appendix.

13th—Sand rock—which brings us to the bed of Licking—30 feet.

The furnace here has been in operation, since the year 1808. There is no lack of ores at present—on the contrary, recent examinations have discovered new beds sufficient for several furnaces. The zone, or belt of ores, is here ten or twelve miles in width, and the works at Granville are supplied from the western border of these deposites—a regular surve would throw great light on the subject of exploration, for ores, and discover many rich beds, where iron has as yet not been sought for. Furnaces in the western states have heretofore used charcoal for smelting; but with the hot blast, bituminous coal will soon supply its place; with a saving of labor, wood, and money.

BITUMINOUS COAL.

Proceeding up the Ohio, after leaving Lawrence County, no additional deposites of iron ore have as yet been noticed, sufficient to attract the attention of the manufacturer; but we find that which is equally valuable, fine beds of coal, without which, in a few years after the forests are destroyed, ores cannot be smelted. A few miles below Gallipolis, fine beds of coal are found on both sides of the river, known as "Semple's coal mines." It is extensively worked, and affords an abundance of fine coal. The most important deposit, however, is found stretching along the borders of the Ohio, from the mouth of Leading creek to two miles above Carr's run, a distance of eight or ten miles by the course of the river. It is generally known by the name of the "Pomeroy coal beds." A northerly bend in the Ohio, has thrown these rich deposites immediately on to the brink of the river. Although the early settlers of the country, looked with an evil eye on the rocky narrows of the Ohio, and considered lands thus situated as nearly worthless, yet we are led to admire the kind hand of Providence, which, by causing the river to flow in sweeping curves, has thus brought the most valuable beds of iron, coal, and sand rock, immediately on to the shores of a navigable stream; and instead of the lengthy rail roads across wide bottoms, which would be necessary were both shores alluvious, the workmen can now transfer the products of the mine, almost immediately from its mouth, into the boat which floats it to market. The mural precipices of sand rocks which line the right bank of the Ohio, not only afford a safe roof to the mines, but also offer an exhaustless store of free stone for architectural purposes, in the erection of the future cities and manufactories, that will spring up along the shores of the river. The coal at these beds is from four to six feet in thickness, and of the best quality for manufacturing purposes, affording a large per cent. of carbon. By a recent analysis it is found to be composed as follows—charcoal or carbon 60 parts—bituminous matter and earth 40 parts—specific gravity 1.22.

The enterprizing individuals who at present own the larger moiety of these beds, have overcome difficulties in transporting a regular supply of fuel to the markets below, which in other parts of the United States, have required the united energies of incorporated companies to conquer. A large steam-boat built expressly for the purpose, tows from four to six loaded barges, carrying each from five to seven thousand bushels of coal to Cincinnati and back again empty; performing the trip in five or six days —at this spot, which three years since looked like a neglected wilderness a smart village has sprung up, filled with an industrious race of men. Steam saw-mills, shops, and a large boat-yard are in active operation. The colliers are chiefly experienced miners from Wales, with their families. A church, and a school-house are about being built from the fine sandstone, for the cultivation of the rising intellect, and encouraging the growth of morality and religion amongst the miners. A spot which a few ago was considered by the neighboring inhabitants as almost worthless, and parcels of the coal lands often actually sold for less than a dollar and a half per acre, is now worth an incalculable sum. How often a community is indebted for its wealth and comfort to the foresight and intellectual greatness of a single individual The lands of the whole surrounding country for many miles, contiguous to the coal beds, have been trebled in value, and an extensive market opened for their surplus produce. Coal will now be supplied with regularity, and in quantity to the inhabitants of Cincinnati, instead of by uncertain boat loads, and at irregular intervals

as heretofore. It will also be of a better quality, as the coal improves, when the beds are followed far under the rocks. With these large supplies of coal, and iron in exhaustless beds, lying directly on a navigable stream, but a short distance above, for steam shortens space, as well as time, "the Queen of the West," is destined to become, and that in a few brief years, the emporium of manufactures; and nothing but a lack of enterprize and inattention to the immense resources heaped up in her vicinity can prevent her taking the lead in the fabrication of all articles manufactured from iron. Enough has been said to awaken the attention of the community to the subject; and a liberal policy in our legislators, authorizing a scientific geological survey of the State, can hardly fail in developing resources before unknown and unthought of, leading to an eminence of wealth and greatness, equal, if not superior to that of any other state in the Union.

The Pomeroy beds, alone, will probably in another year furnish a million of bushels of coal to the markets on the shores of the Ohio; and other beds seated along its borders can supply additional amounts equal to the demands of the manufacturer and for domestic purposes.

As we proceed up stream, no other considerable beds are found near the river for the distance of one hundred and forty miles, or until we reach Pipe creek, sixteen miles below Wheeling. Here the coal which has traversed the higher strata along the adjacent hills, bordering the river, for many miles above Wellsburgh, gradually dips below the bed of the river, and is seen no more in thick beds until it appears at Carr's run.

In Ohio, opposite to Wheeling, and in the counties of Belmont and Jefferson, coal is found in three distinct deposites and in exhaustless quantities; but those beds near a navigable stream, must ever be deemed much the most valuable and important. It is also discovered as far north as Portage and the S. E. corner of Medina county, in considerable quantities—but the main deposites are south and east of these lines and in fact all round the inner margin of the sand stone basin, especially in the counties of Athens, Perry, Muskingum, Coshocton, Tuscarawas, Carroll, and Columbiana. Canals and rail-roads will in a few years make these deposits available to those portions of Ohio, which lie without the coal region.

FINE GRAINED SAND ROCKS.

In describing the iron ore deposits of Scioto county, it will be recollected that the bed No. one is noted as resting on a fine grained sand stone. This rock forms the upper surface of a very extensive deposit, underlying the iron ores and the coarser sand rocks, and coal, mentioned in the commencement of the Report. As this rock descends deeper into the earth it becomes more argillaceous; and at the depth of one hundred feet changes, to or rather rests on, a bed of clay state, of a light dove color, easily decomposing, when exposed to the weather. Underlying this rock, at the depth of 340 feet, there are many reasons for believing, there is a bed of coal twelve feet in thickness. It has been pierced at two different points in boring for salt water. So certain and plain were the evidences of its actual existence, that a shaft, eight or nine feet in diameter was sunk to the depth of one hundred and fifty feet in search of the coal, in the year 1833. But untoward events happening to the company, the further progress was laid aside, with the intention of resuming the work at a more favorable period. In a conversation, with one of the original occupants of the salt well, bored at this spot, the evidences of a coal bed of this thickness were very satisfactory. Salt water was found below the

coal of unusual strength, but would not rise to the surface in the usual manner, common at other wells and was therefore abandoned. Should this coal be ultimately obtained, it will be of incalculable benefit to the iron manufactures of this vicinity. The shaft was sank near the mouth of Man's creek four miles above Portsmouth, on the Ohio. On the diagram, the supposed position of this bed is laid down.

On the west side of the Scioto, near its mouth, the upper beds of this fine sand rock have been extensively opened, and the rock sawn into slabs and other forms useful in architecture, by a mill moved by water power, supplied from the canal. The stone is just rising into notice, and the demand for columns, capitals, plinths, &c. is already far beyond the means of the proprietor to supply. Some of the whiter varieties, when wrought by the chisel and ornamented, furnish an article which vies with white marble in beauty. It is sufficiently firm to allow of the most delicate execution, in raised ornamental figures; and is said to bear the vicissitudes of our climate withot decomposition. Its termination westerly is not yet ascertained; but it extends up the Scioto for many miles, and the beds at Waverly are already known, at Columbus, and in some of our principal inland towns, as affording a most beautiful and durable material for architectural purposes. In a country destitute of marble this fine grained sand rock will furnish an equivalent, of immense value and importance. It will be the duty of the geologist to point out the various spots where this rock may be found, at localities far beneath the surface, and which may be reached by shafts, in the manner pursued at Paris and many other places in Europe.

CALCARIOUS ROCKS.

The western and central divisions of Ohio, beyond the coal measures, are based on horizontal beds of lime-stone, supporting rich prairies. The deeper strata from the absence of hills, are as yet but little known; but may possibly contain valuable beds of anthracite. This supposition is strengthened, from observations made by the chairman of the committee in a visit last summer to the Delaware Sulphur Springs. In breaking fragments of the lime rock about Delaware, he noticed a strong bituminous effluvia; and in a conversation with an old quarry-man, he learnt that small cells are found in the rocks filled with petroleam, or "spring oil." The gas discharged from the spring is sulphurated Hydrogen, both which products are known to be furnished by coal. From these indications it will be worthy the attention of the Geologist, should a survey be directed by the state, to cause borings to be made through the lime-stone rocks, to the depth of several hundred feet, similar to those made in search of salt water, at various points in the interior, where no indications of coal, are noticed on the surface. It may also bring to light other valuable minerals. The time is not distant when all that portion of the state occupied by prairies, will need more fuel than can be furnished by the forests, and could coal be found at a moderate depth, the value to the inhabitants would be incalculable.

SALT WATER AND SALT.

This article, so indispensable in the economy of civilized man, and so abundantly procured at various points through the hilly, sandstone region, has not yet been found in any considerable quantity, beyond the limits of the coal measures. Within these boundaries it has been discovered and manufactured, at Leading creek, Hockhocking, Muskingum, Wills creek, Duck creek, and Yellow creek. It is highly probable that a scientific survey would discover indications of this mineral at points now little

thought of in the N. Western portions of the State. This supposition is strengthened from the fact of Sulphate of Lime, or "Plaister of Paris," a well known concomitant of fossil salt, being found at Sandusky bay; and also from the curious circumstance of the Moravian Missionaries, having made salt from springs, found near the outlet of Lake St. Clair as early as the year 1783, as noted in Loskiel's history of the Moravian Missions. The product of this article in Ohio, has become so great, that it may be accounted one of its staple commodities. The nett annual amount of all the works cannot be less than half a million of dollars.

"BEST METHOD OF CONDUCTING THE SURVEY."

In the opinion of your committee, the better mode of conducting the survey, will be by constituting a Geological Board, of three members; who should direct the manner of proceeding; employ suitable geologists &c. with power to draw on the Treasurer, or the deposites annuully appropriated for this purpose; or otherwise, the present Board of Public Works, might perform this duty, as might be deemed most expedient.

"COST OF THE SURVEY."

From a correspondence held by the chairman with several distinguished and practical men in geology, your committee are led to believe that the sum of $12,000 dollars, for four years would cover the cost of a regular scientific survey. It would require the services of one head, or principal geologist, and five assistant geologists. One draughtsman, one naturalist. Their salaries, travelling expenses, and other incidental charges would amount to nearly this sum. The survey to be complete, and most useful to the community, ought not only to embrace the simple geology, but also the topography, botany, so far as to include a list of the plants found in the State, forest trees, river and land shells, fishes, birds, quadrupeds, and reptiles—and last, not least, a regular survey and description of all the remnants of ancient works, yet spared by the hand of the destroyer within the state. These relics of a departed and more than half civilized race, it is our duty to preserve for those who come after us, in the only way now left for many of them, by accurate drawings and descriptions of all such as can be distinctly traced. It should also be enjoined on the surveyors to collect all the remains of art belonging to this race, whom we have many reasons for believing were the ancestors of the Mexicans, such as pottery, sculpture in stone, offensive weapons, ornaments &c. to be placed in a cabinet in the State Library Hall—with specimens of all the rocks, minerals, fossils &c. in a regular geological series, not only for the State, but also a suit for each of the collleges. These Collections would be of immense value to the student of geology, mineralogy, and the practical miner; as well as to the future historians of the State.

CONCLUSION.

Although many things yet remain unnoticed, such as the marls of Wayne and Stark counties; the silicious or Burrh millstone deposits, stretching diagonally across the State, with several other important subjects, yet your committee trust and believe that they have pointed out sufficient motives to render a survey of the state an object of deep importance to he welfare of the citizens of Ohio. The increased value of real estate, or the additional revenues derived from the canals and rail roads, from new articles of transport brought to light by the survey, would in a single year, probably more than repay the cost of accomplishing it. Several of the eastern States, whose territories contain far less mineral treas-

ures than Ohio, have already either accomplished, or are now entering upon, geological surveys. That great and public spirited State, New York, ever amongst the foremost in the march of improvement, has taken up the subject with a zeal and an outlay, commensurate with so noble an object. Virginia, our next neighbor, is on the alert; searching with all the aids of science not only amidst her mountain ranges of auriferous rocks, and golden sands, but also her ferruginous, salt, and coal deposits, the counterparts of our own. And shall Ohio, already the third state in the Union for physical power, remain behind her sisters in the scientific improvements of the age?

S. P. HILDRETH, *Chairman.*

Postscript.—The other members of the committee, Mr. Riddle and Mr. Lapham, being both absent from the state, and Dr. Lock occupied with his duties as Professor in the Medical College of Ohio, has necessarily prevented the signature of their names to the report.

Mr. Riddle, in the course of the last summer, made a tour of exploration through the north western and central portions of the state, and collected many valuable geological facts, which have not yet come into the hands of the chairman. Dr. Locke, who kindly undertook the analysis of the iron ores, referred to in the report, has been prevented, by unexpected events, from accomplishing the task in due time; they will however, be furnished in a few weeks, and will be very valuable to persons engaged in the manufacture of iron, as well as to general science.

ANALYSIS OF THE LIME-STONE OF CINCINNATI AND DAYTON.

BY JOHN LOCKE, M. D.

One hundred grains of the grey lime-stone from the hills of Cincinnati, yielded the following ingredients:

	Grains.
1. Carbonate of Lime,	90,93
2. Peroxide of Iron,	3,15
3. Matter insoluble in Muriatic acid,	1,80
4. Carbonate of Magnesia,	1,11
5. Silex from solution,	0,77
6. Water, &c. expelled by red heat,	1,13
Loss,	1,11
	100,00

One hundred grains of the cream colored lime-stone from Dayton, yielded the followtng ingredients:

	Grains.
1. Carbonate of Lime,	92,40
2. Peroxide of Iron,	0,53
3. Matter insoluble in Muriatic acid,	1,70
4. Carbonite of Magnesia,	1,10
5. Selix from solution,	0,90
6. Small crystals of iron Pyrites,	0,10
7. Water, &c. expelled by red heat,	1,08
Loss,	2,19
	100,00

The matter, in the Cincinnati Limestone, insoluble in Muriatic acid is of a dark lead color. It is evidently silex and alumine, not combined

with the carboniate of Lime, but mechanical interposed between the natural joints of the crystals, and there giving the color to the whole stone. The similar substance of the Dayton Limestone is of a cream color; and that from a specimen of saccharine white marble from Italy, was in very small quantity and white. The dark color of the Cincinnati Limestone when slacked, and which renders it unfit for white washing, is caused by the superior quantity of iron which it contains. This analysis will serve to settle one point of some consequence in Cincinnati. Our masons have formerly pleaded that the Cincinnati Lime is of so 'hot a nature' that they were compelled to use loam in their mortar. The introduction of this loam in large quantity when they furnished the materials, was obviously to their advantage; and in some cases it almost excluded the more expensive materials, lime and sand. When masons do not pay for materials, but are employdd to perform the labor merely, the temptation to introduce the loam (a species of clay,) is not so obvious to the employer. The temptation is this: when the mortar is a large proportion of it mud, it does not harden ('set') so soon, and the mason can throw on a 'run' of perhaps ten bricks which he can lay in succession without being interrupted by laying mortar; while with mortar composed of pure lime and sand not more than two or three bricks could be laid at once. It is on account of the use of this imperfect mortar that the tops of our chimneys and copings of walls are so soon dilapidated. Now as the pure chymical principle of Lime is every where the same, and our Lime contains at least 93 parts in a hundred of it, this 'hot quality' is imaginary. Many of our best masons are now building with pure lime and sand to the exclusion of loam;—an improvement which I hope will be encouraged. The analysis shows the presence of Magnesia, but in too small a proportion to injure it in the least for agricultural or other uses. The Magnesian carbonate of Lime contains 45 per cent. of Carbonate of Magnesia, while ours has only about 1 per cent. The specific gravity of both the Dayton and Cincinnati specimens was 2.7. Very few specimens of Lime stone are known purer than those subjected to the above analysis.

APPENDIX A.

On the application of the Hot Blast, in the Manufacture of Cast Iron, by THOMAS CLARK, M. D. (*Trans. of the Royal Society of Edinburgh.*)—*Copied from the Amer. Jour. Sci. for Oct.* 1836.

"The substitution of hot for cold air, in the blast furnaces of the iron manufactory, is an improvement which suggested itself to the ingenious Mr. Neilson, of Glasgow, at a most seasonable period, when the great demand for iron in the construction of rail-ways, is daily, nay, hourly, increasing.

"The original process consisted in introducing a charge of coke, limestone, and burned iron stone, into the top of the furnace; and this mixture was excited to combustion by air forcibly driven in, at about forty feet from the top, through pipes from a blowing apparatus. The iron was thus separated from carbonic acid, alumina and silica—and was allowed to run off at the bottom.

"Mr. Neilson improved this process, by substituting for air at the temperature of the atmosphere, air heated up to 300 degrees, and upwards.

This is effected by passing the air through the cast iron pipes, by which the former passed, kept at a red heat.

During the first six months of the year 1829, when the cast iron in the Clyde iron works was made by means of the cold blast, a single ton of cast iron required for fuel to reduce it, 8 tons 1¼ cwt. of coal converted into coke. The saving amounts to 2 tons 18 cwt. on the making of one ton of cast iron—but from that saving comes to be deducted the coal used in heating the air, which was nearly eight hundred. The nett saving was thus 2½ tons of coal on a single ton of cast iron. But during the year 1830, the air was heated no higher than 300 degrees Farenheit. The great success, however, of these trials, encouraged Mr. Dunlop, and other iron masters, to try the effect of a still higher temperature. The saving of coal was greatly increased, insomuch that about the beginning of 1831, Mr. Dixon, proprietor of the Calder iron works, substituted raw coal, for the coke before in use. Proceeding on the ascertained advantages of the hot blast, the attempt was entirely successful; and since that period, the use of raw coal has extended so far as to be adopted in the majority of the Scotch iron works. The temperature of the air under blast, had now been raised so as to melt lead, and sometimes zinc, and therefore was above 600 degrees Farenheit, instead of 300 degrees, as in the year 1830.

"During the first six months of the year 1833, when all these changes had been fully brought into operation, one ton of cast iron was made by means of 2 tons and 5¼ cwt. of coal, which had not previously been converted into coke—add to this 8 cwt. for heating the air, and we have 2 tons 13¼ cwt. of coal required to make one ton of iron: whereas, in 1829, with the cold blast, 8 tons 1¼ cwt. of coal had to be used. This being three times as much, we have from the change of the cold blast to the hot, combined with the use of coal instead of coke, *three times as much iron made from any given weight of splent coal.*

"The furnaces at Clyde iron works, which were at first three, have increased to four; and the blast machinery being still the same, the following were the successive weekly products of iron during the periods already named and the successive weekly consumption of fuel put into the furnace apart from what was used in heating the blast:—

	Tons.	*Tons.*	*Tons.*
In 1829, from 3 furnaces	111 iron	from 403 coke,	from 888 coal.
In 1830, from 3 furnaces	162 iron	from 376 coke,	from 836 coal.
In 1833, from 4 furnaces	245 iron		from 554 coal.

"Comparing the product of 1829 with that of 1833, it will be observed, that the blast in consequence of being heated, has reduced more than double the quantity of iron. The fuel consumed in these two periods we cannot compare, since in the former coke was burned, and in the latter coal. But in comparing the consumption of coke in the years 1829 and 1830, we find that although the product of iron in the latter period was increased, yet the consumption of coke was rather diminished. Hence the increased efficacy of the blast appears to be expected, from the diminished fuel that had become necessary to smelt a given quantity of iron.

Materials constituting a Charge at the Clyde Works.

In 1829:—

Coke, 5 cwt. 0 qr. 0 lbs.
Roasted iron stone, 3 cwt. 1 qr. 14 lbs.
Lime stone, 0 cwt. 3 qrs. 16 lbs.

In 1833: with the hot blast:—

Coal, 5 cwt. 0 qrs. 0 lbs.
Roasted iron ore, 5 cwt. 0 qrs. 0 lbs.
Lime stone, 1 cwt. 0 qrs. 0 lbs.